

# ***ENVIRONMENTAL CHEMISTRY OF MERCURY***

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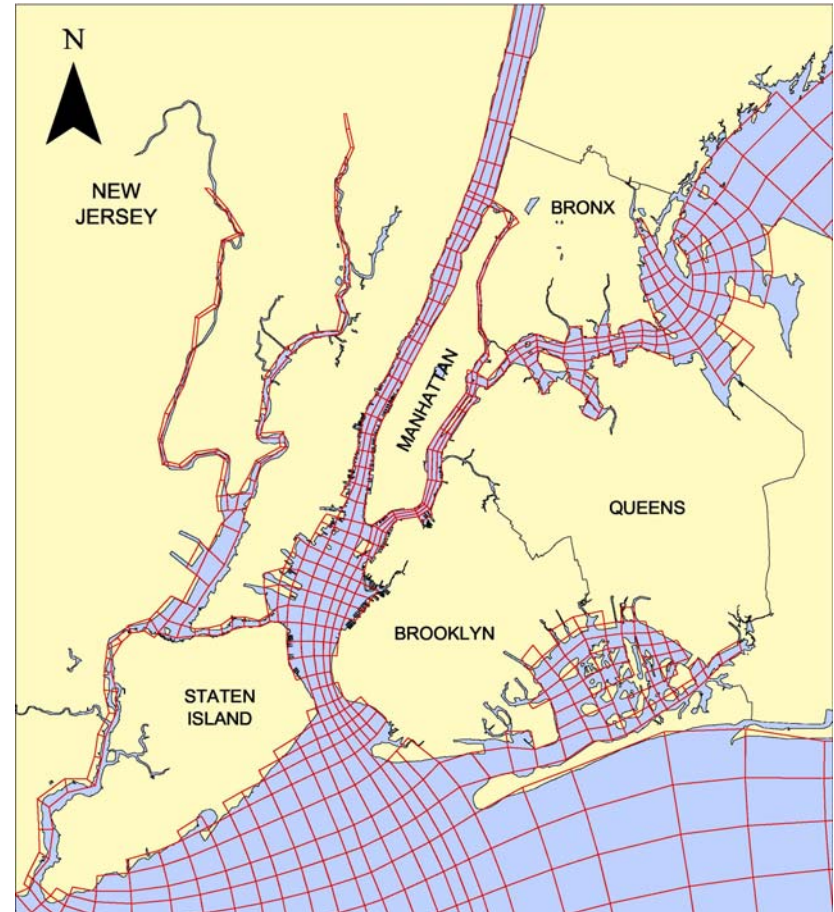


# Outline

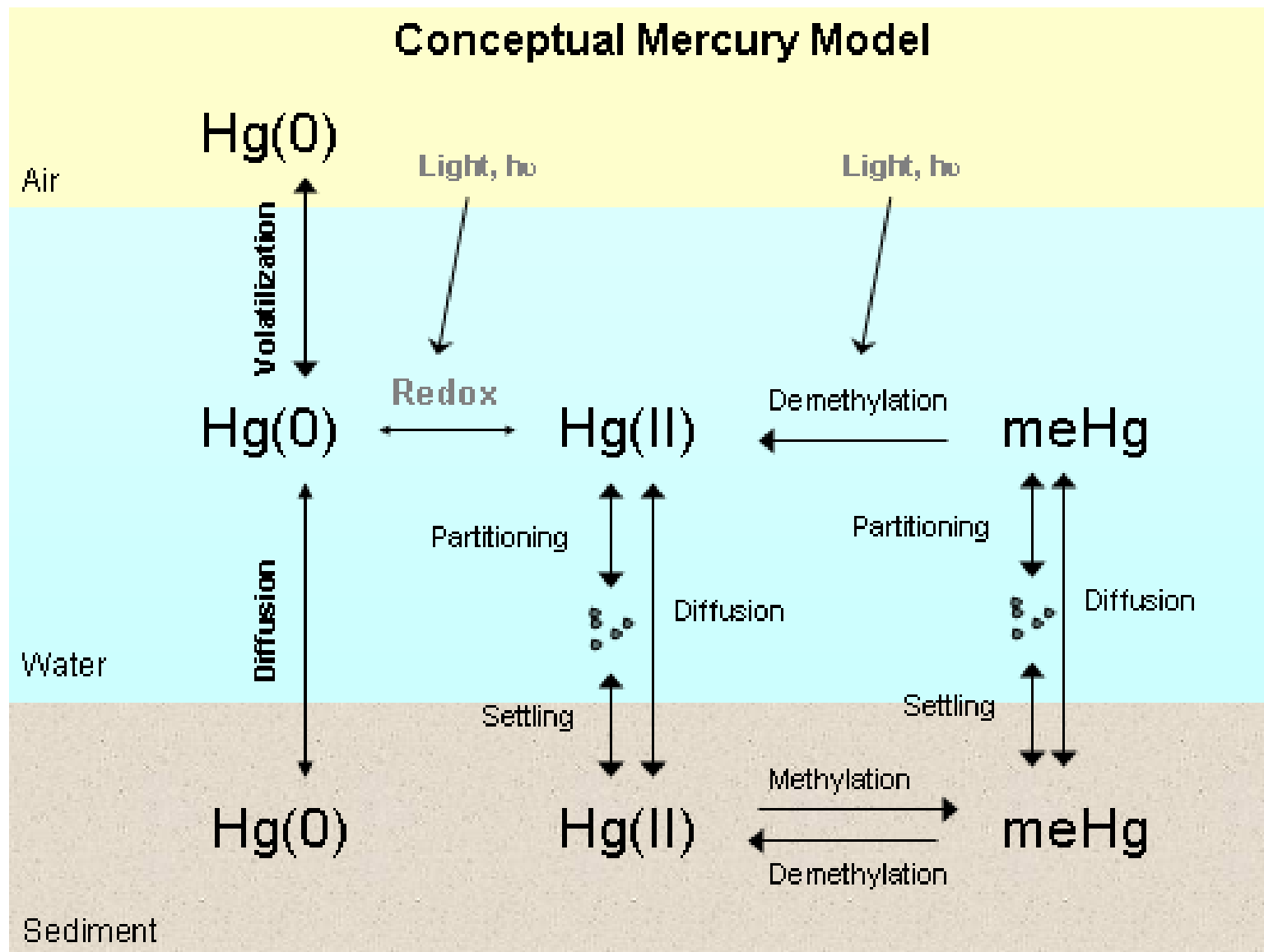
- Lessons Learned from NY/NJ Harbor model experience
- Total Mercury
  - Conceptual model
  - Bulk and detailed speciation
  - Bioavailable forms
- Methylmercury
  - Conceptual model
  - Relationship between sulfate reduction (and bioavailable Hg) and methylation

# NY/NJ Harbor Water Quality Modeling Framework

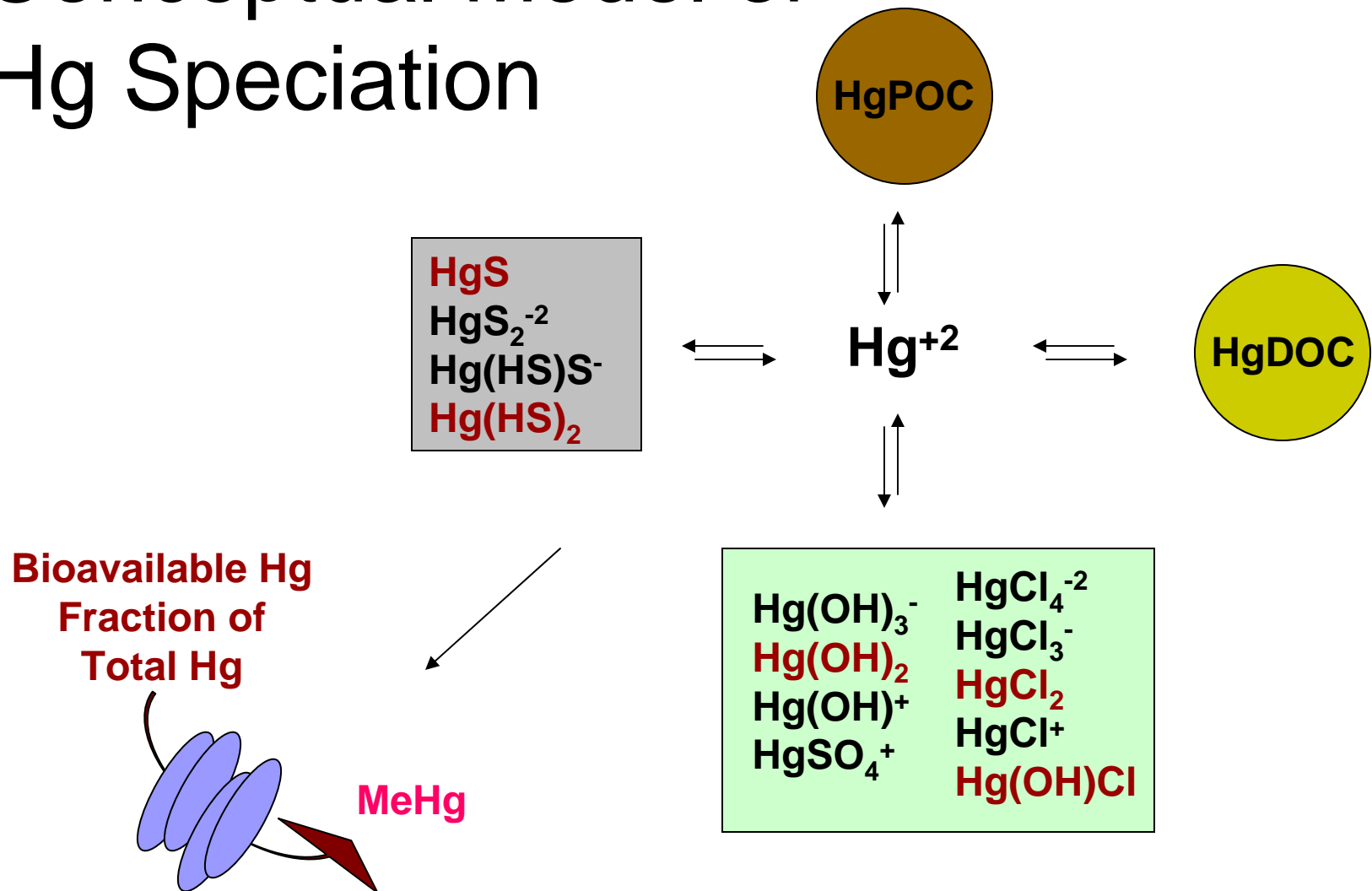
- Peer Reviewed
- Includes hydrodynamics, eutrophication, sediment dynamics
- Adapted to include chemical speciation of Cd, Hg, meHg
- Methylation and demethylation kinetics included
- Coupled to foodchain model



## Conceptual Mercury Model

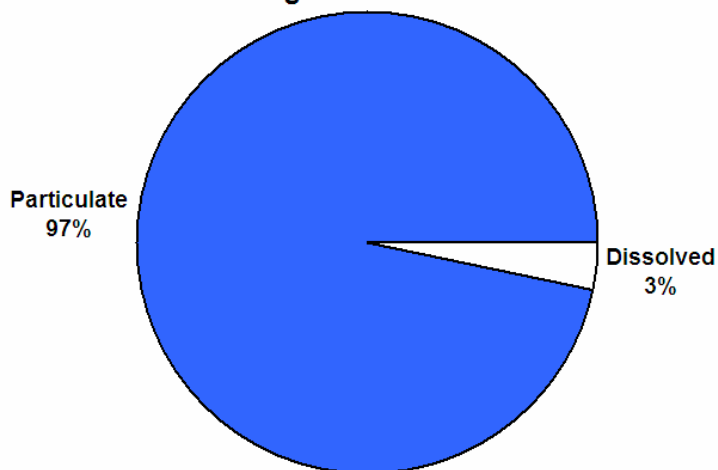


# Conceptual Model of Hg Speciation

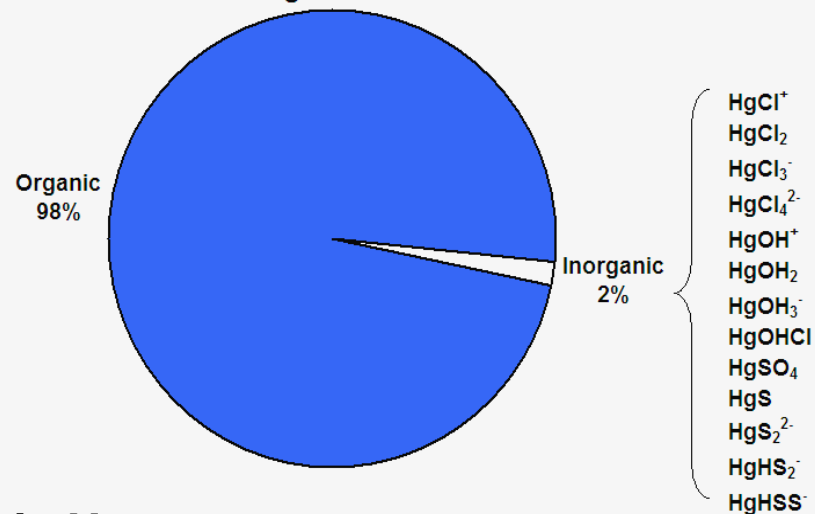


# Water Column Hg Distribution

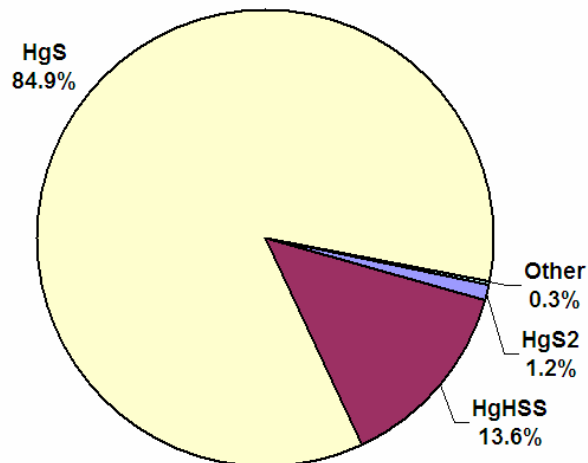
Battery Park  
Total Hg in Water Column



Battery Park  
Dissolved Hg in Water Column



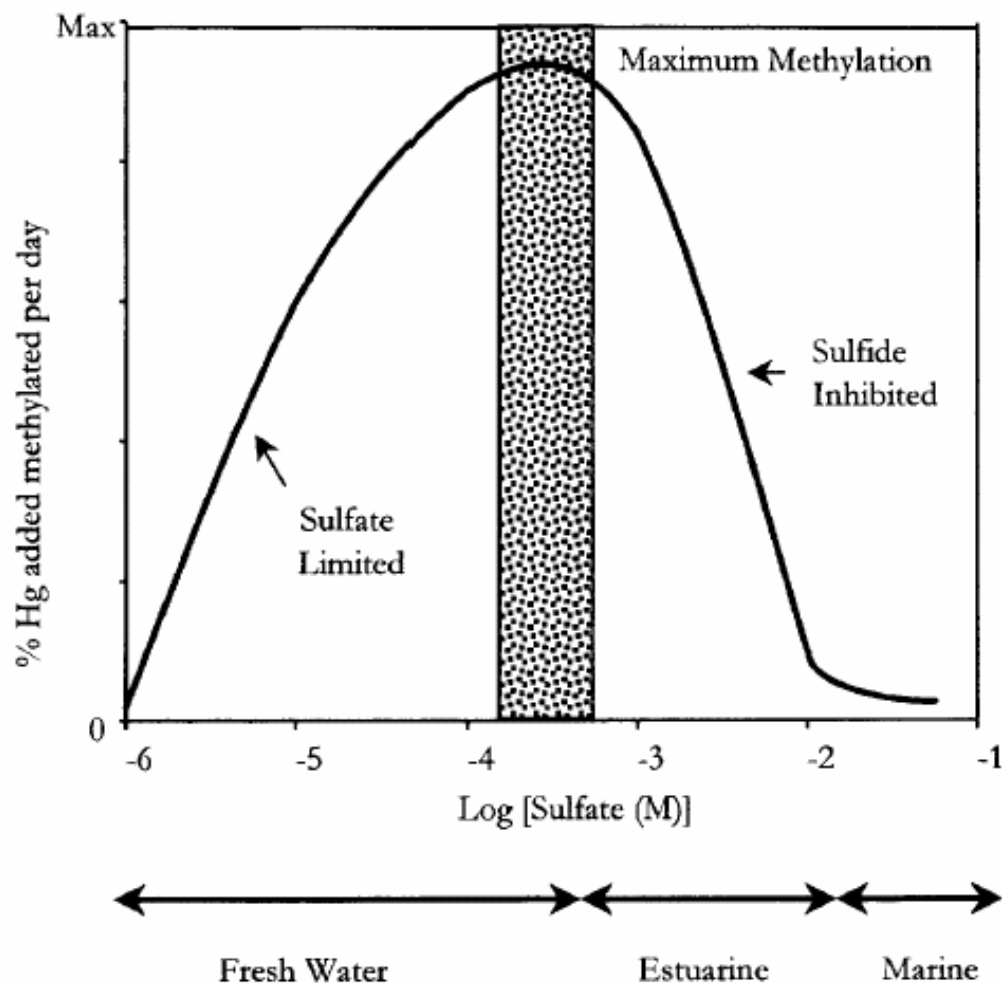
## Dissolved Inorganic Hg



# Methylation of Hg(II)

- Methylation rate is elevated in anoxic environments, such as sediments
- Related to microbial activity
- Requires a bioavailable form of Hg(II)
- Bioavailability to microorganisms is higher for some forms of Hg(II) including non-ionic chemical species

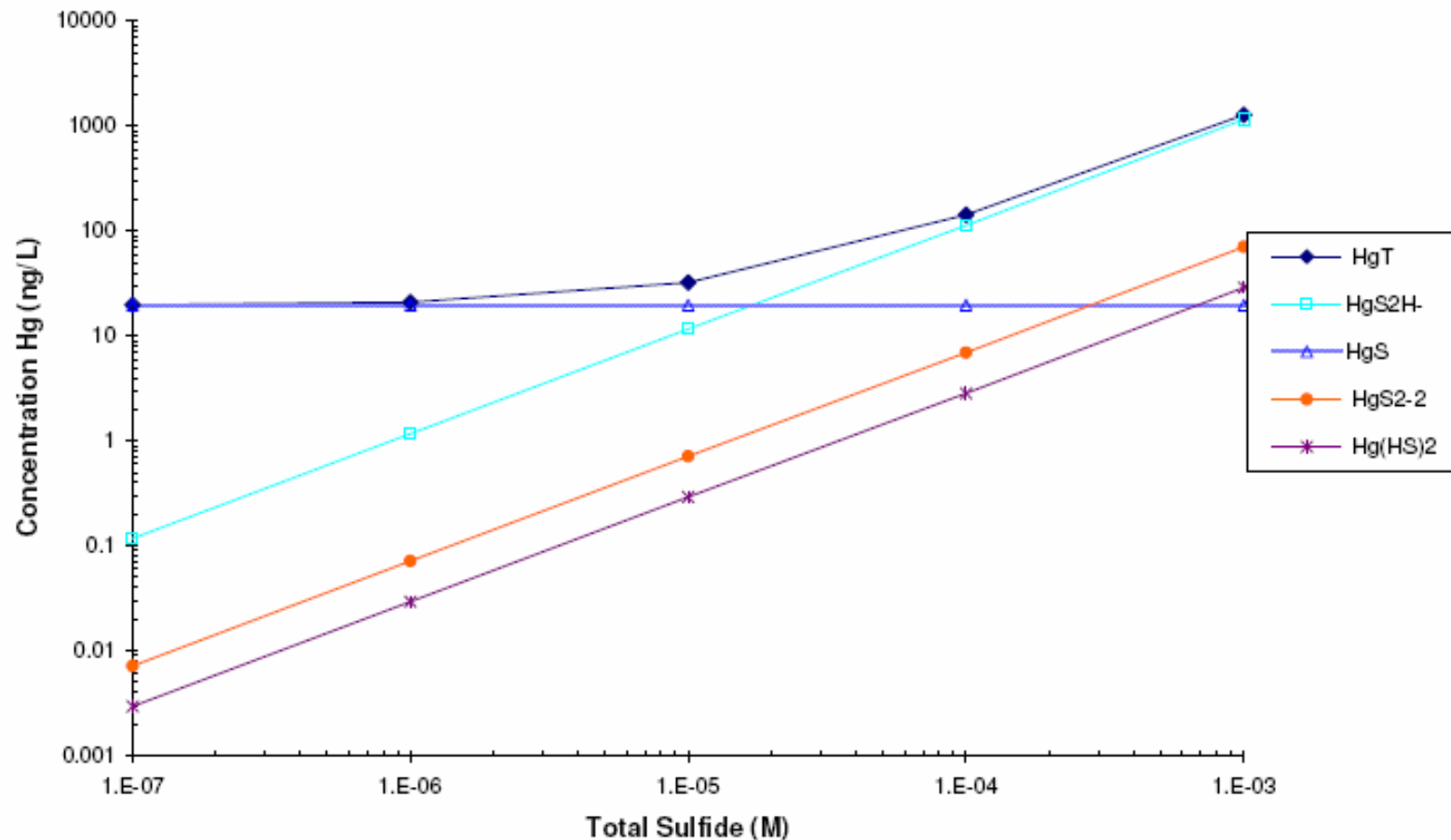
# Conceptual model of Mercury Methylation<sup>1</sup>



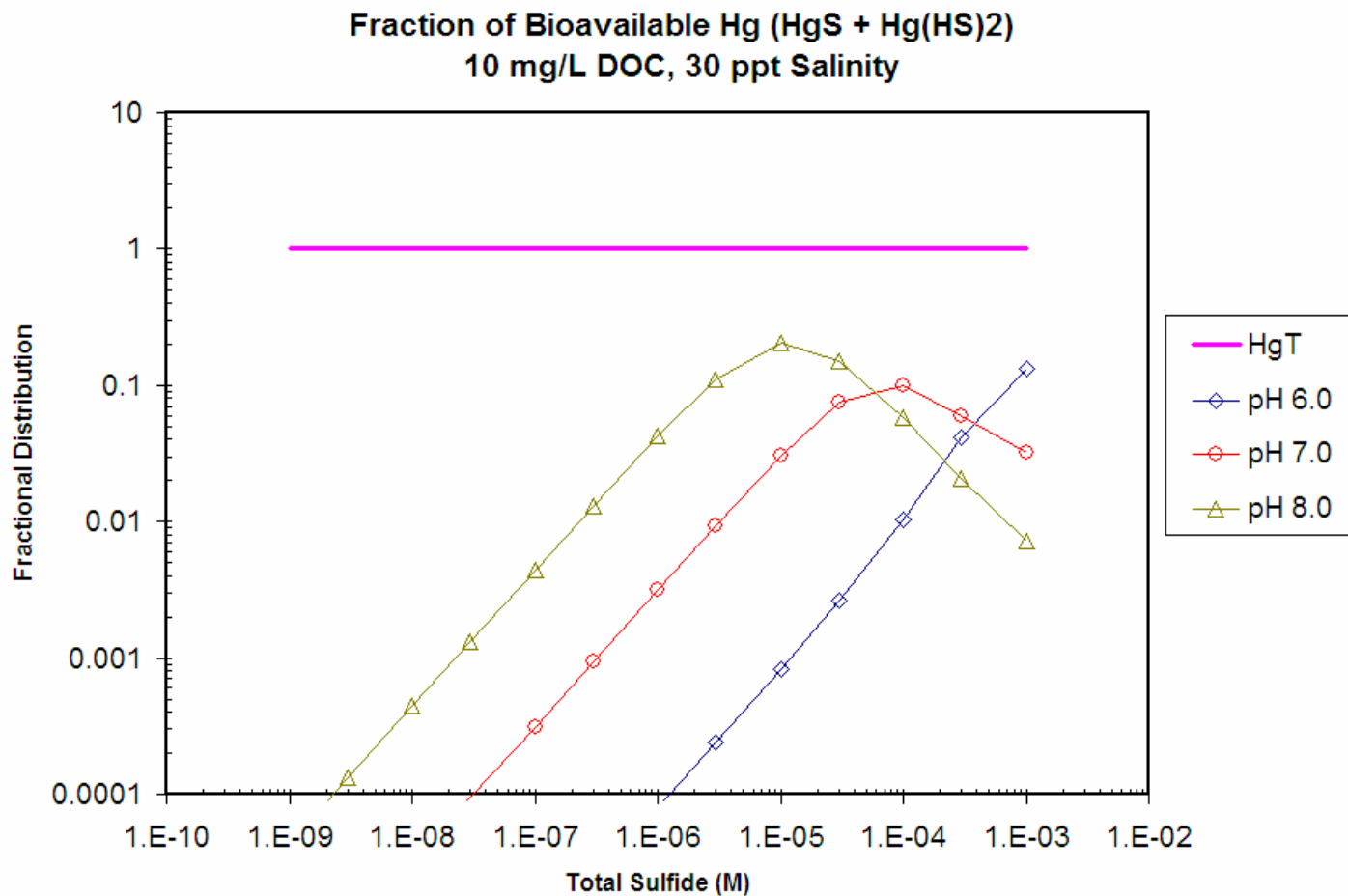
<sup>1</sup>Gilmour and Henry 1991 as redrawn by Langer et al 2001

# Porewater Hg Speciation

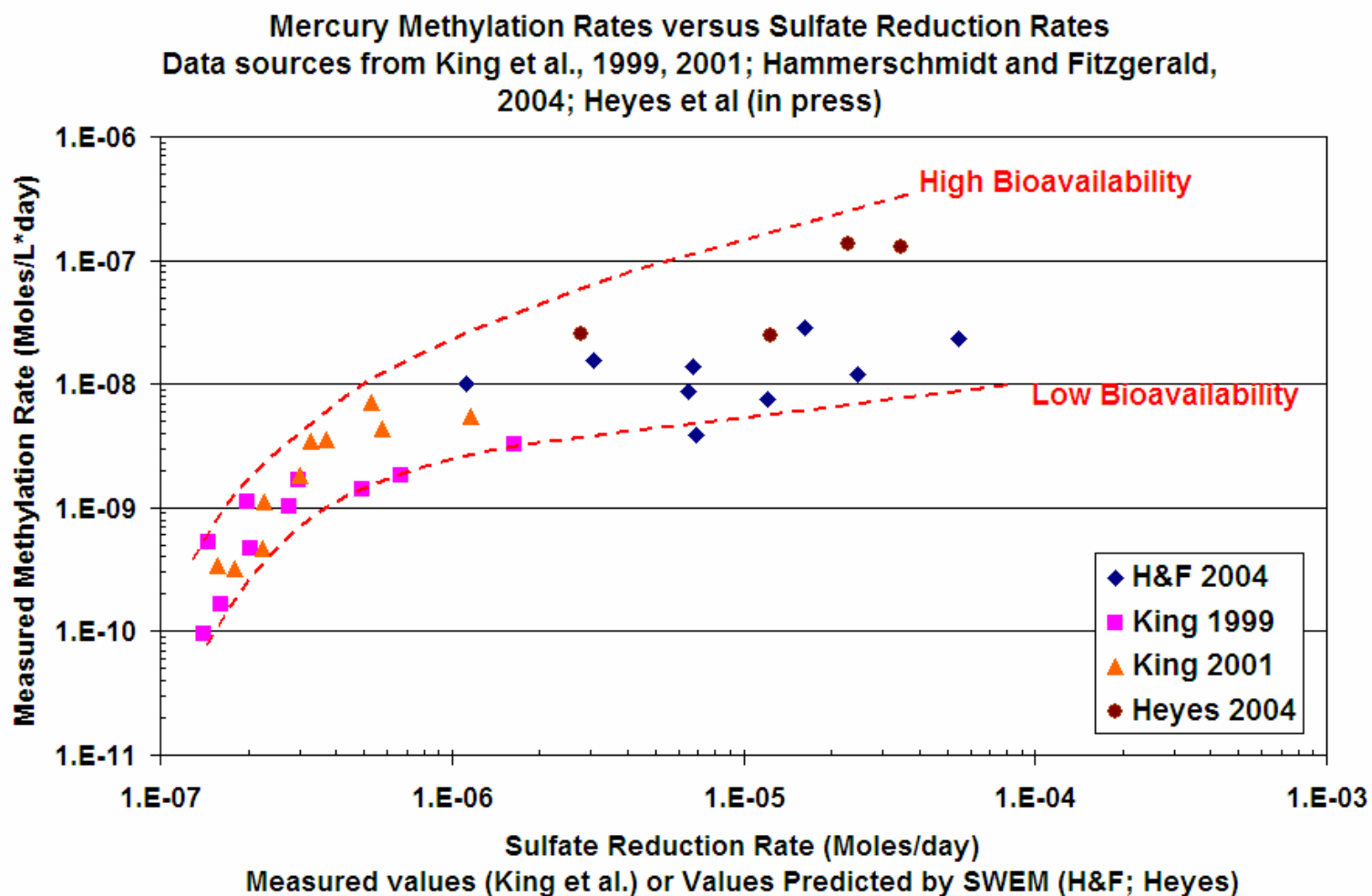
**Hg Speciation vs Sulfide**  
In Equilibrium with Cinnabar ( $\text{HgS}_{(s)}$ ) Solubility at pH 7.0



# Fraction Bioavailable Hg

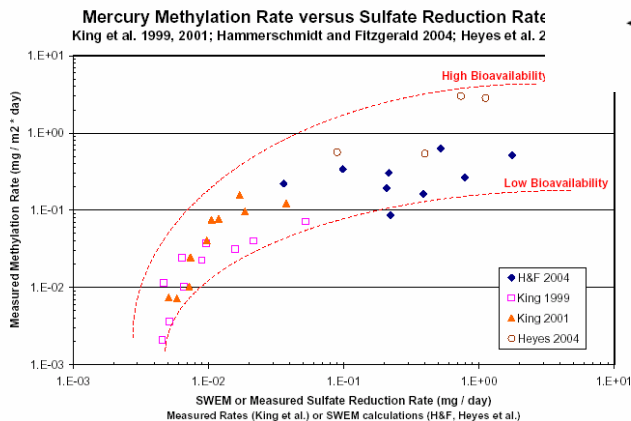
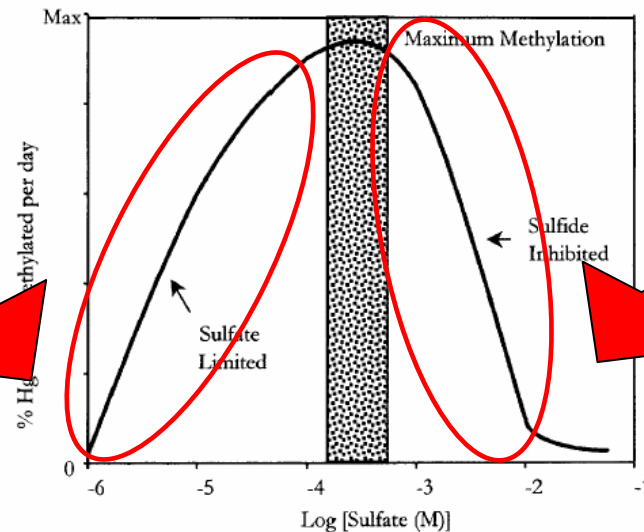


# Mercury Methylation Rates vs Sulfate Reduction Rates

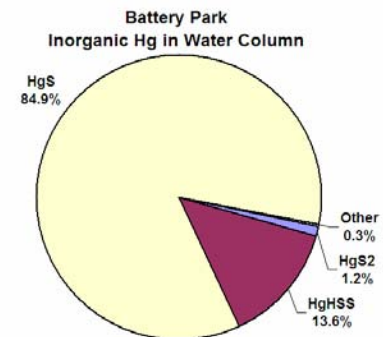


# Conceptual model of Mercury Methylation

(Gilmour and Henry 1991 as redrawn by Langer et al 2001)



← Fresh Water      Estuarine →



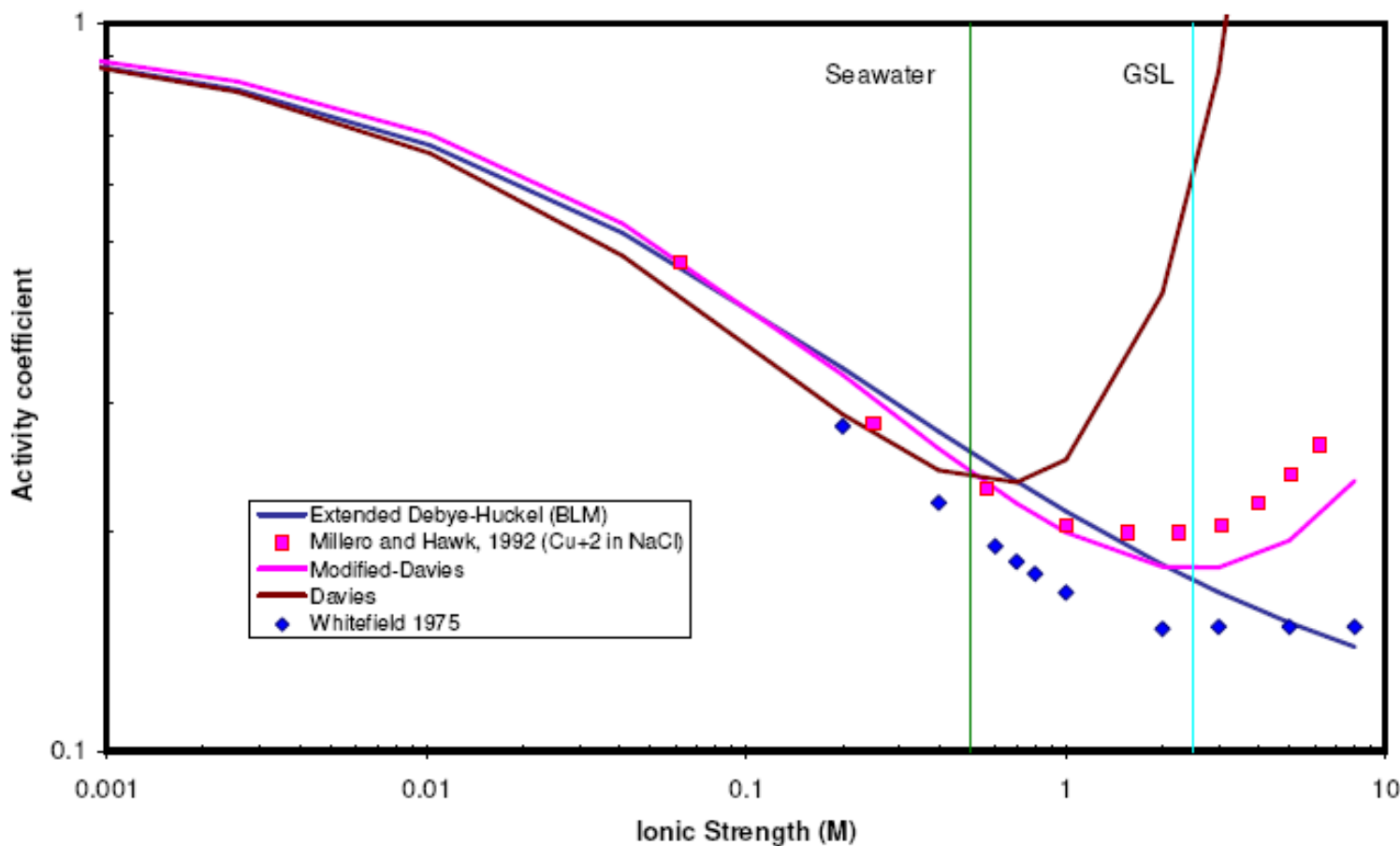
# Conclusions

- Chemical factors such as pH, NOM, and sulfides can all affect mercury methylation
- Biotic factors can also affect methylation rates
- Net methylation can vary spatially and seasonally in a water body

# Hg activity in GSL: modeling perspectives

## Extended Debye-Huckel generally sufficient

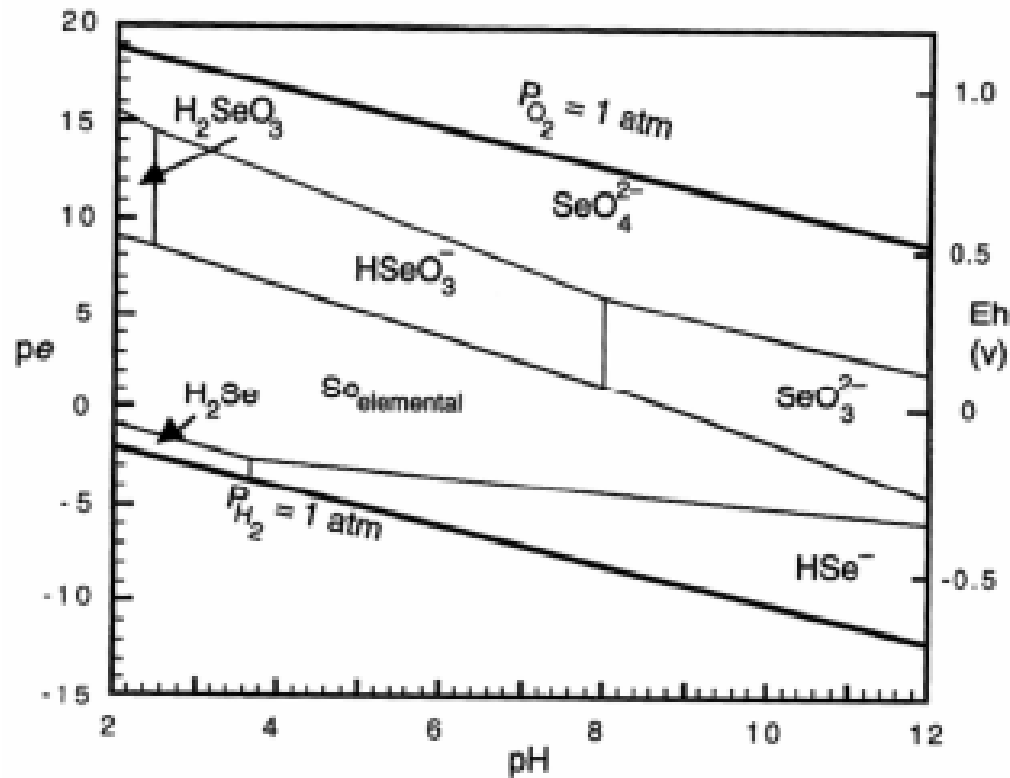
Activity coefficients for  $\text{Cu}^{+2}$



# Extra Slide:

## Perspectives on Selenium and Mercury

### Sediment vs Biota



Drever 1997